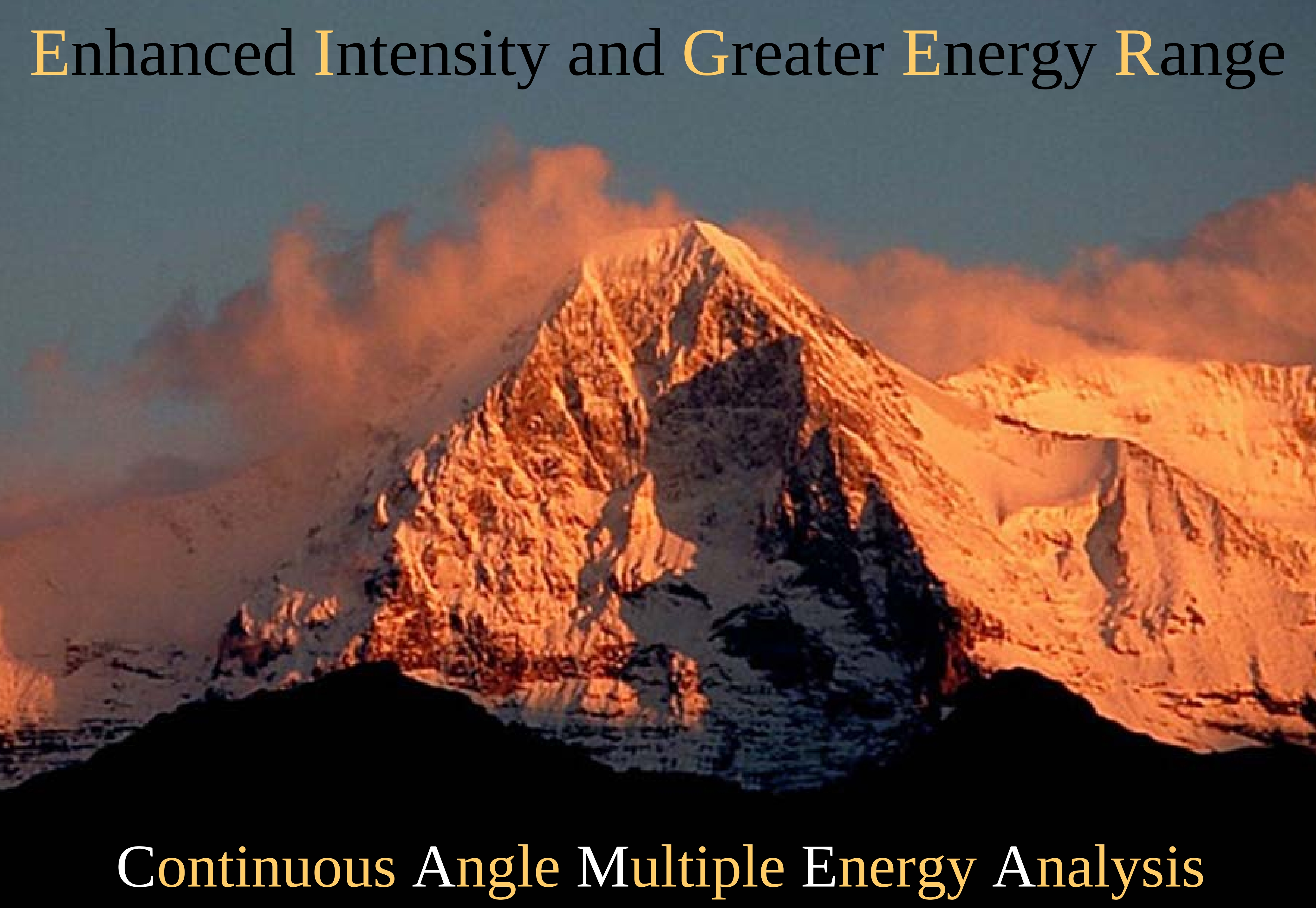
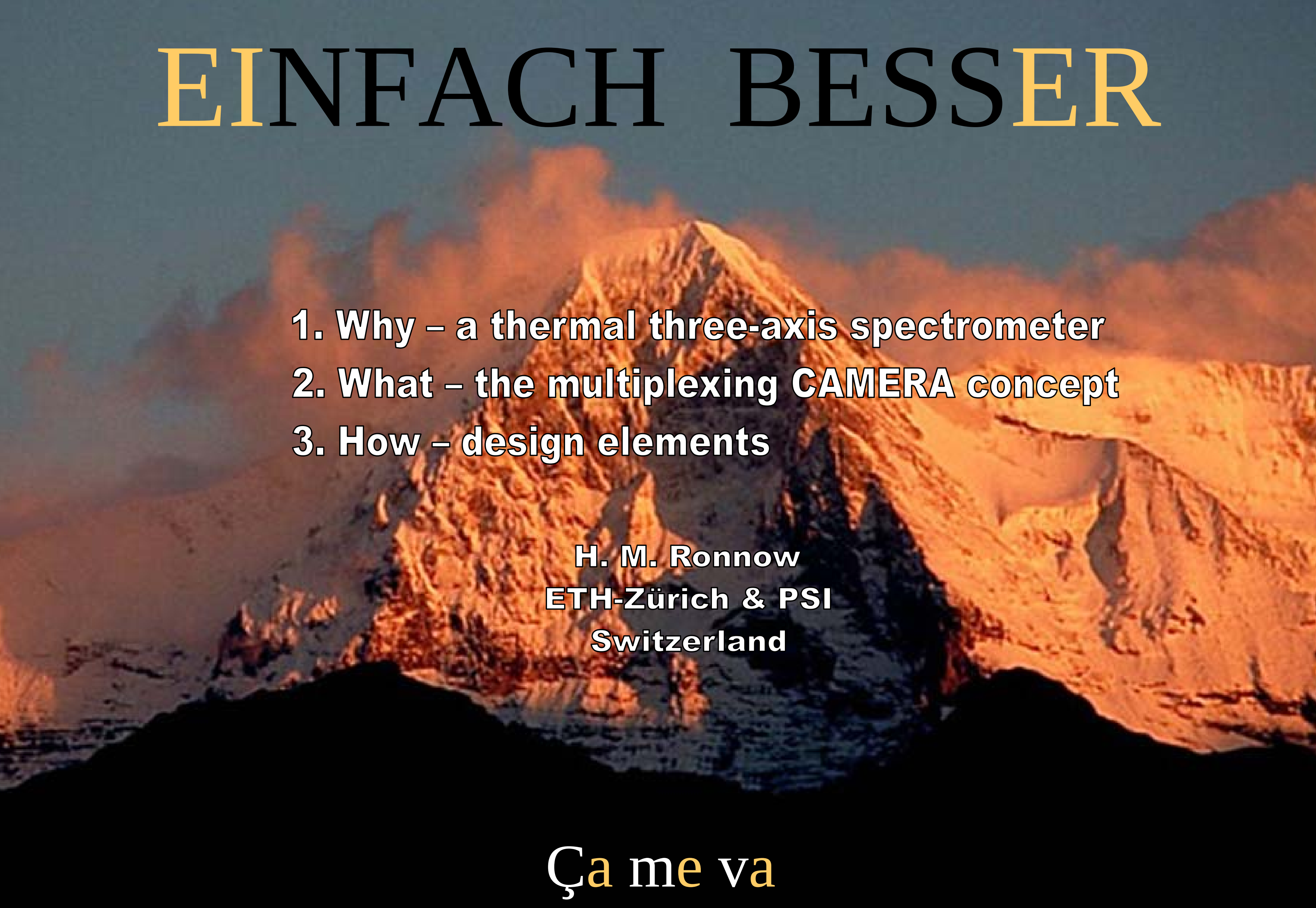
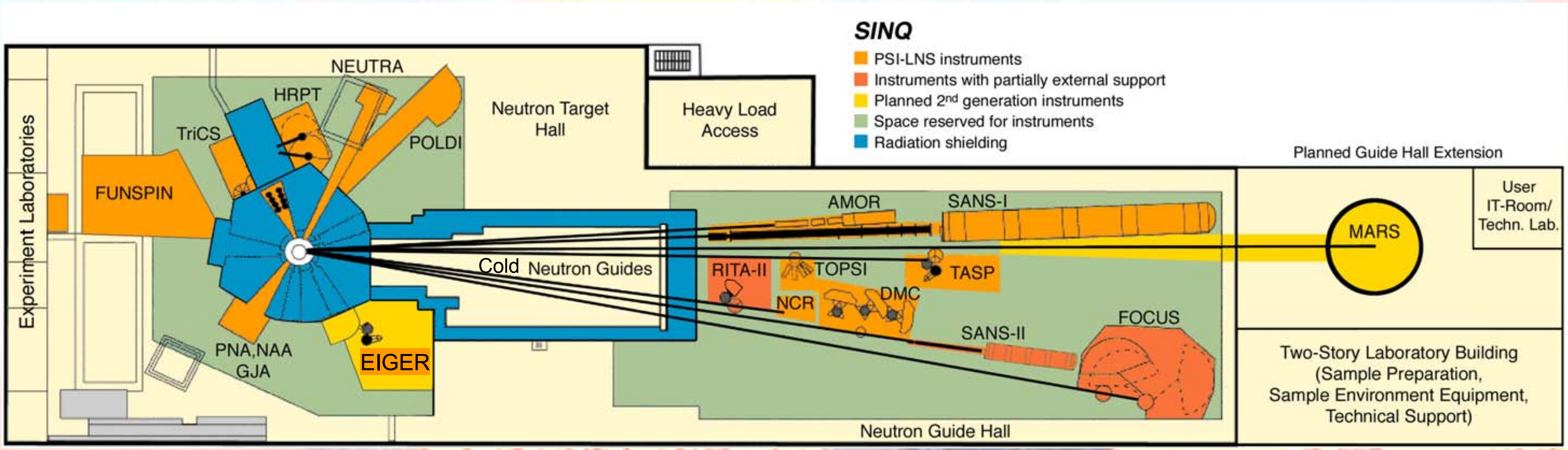

Enhanced Intensity and Greater Energy Range
Continuous Angle Multiple Energy Analysis


EINFACH BESSER
1. Why – a thermal three-axis spectrometer
2. What – the multiplexing CAMERA concept
3. How – design elements
H. M. Ronnow
ETH-Zürich & PSI
Switzerland
Ça me va

Paul Scherrer Institute

- Continuous spallation source SINQ

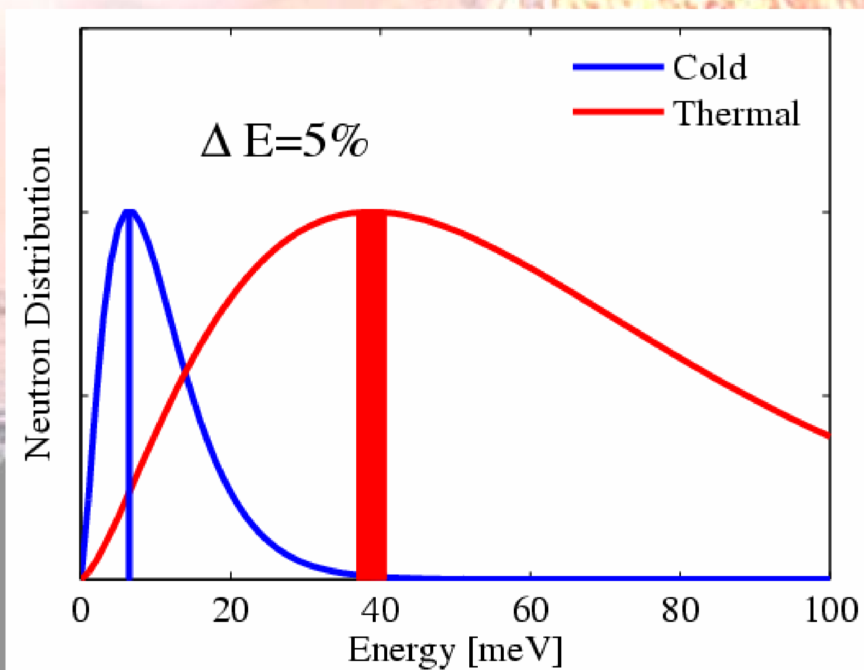


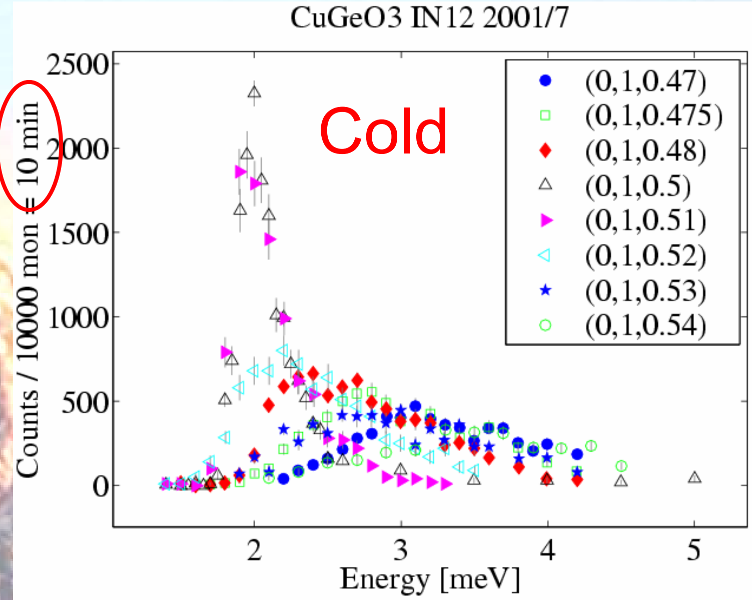
- Flux 3×10^{13} n/cm^{2}s = ILL/30
  - 1.7 $\Rightarrow$ 2.5 mA proton beam $\times1.5$
  - Megapie target $\times1.4$ -1.8

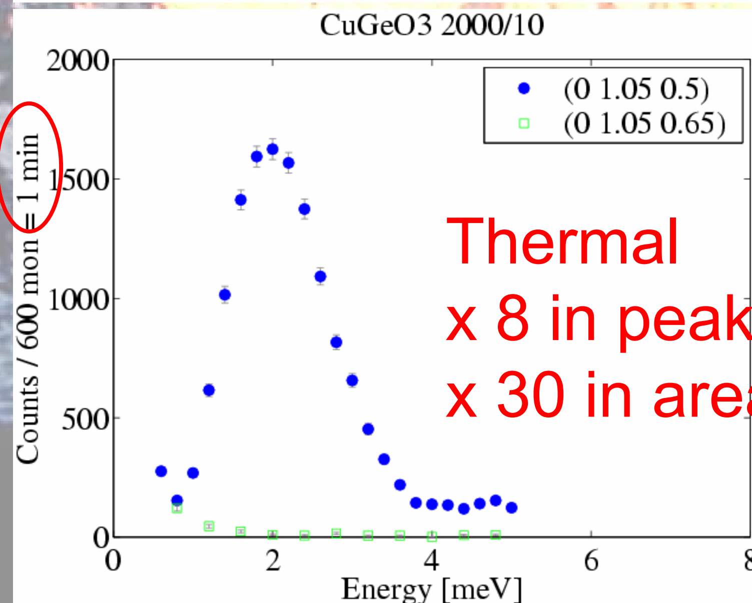
  } $\times2.0$
- 15 instruments, 600 expts/year, single and long term proposals
- 2 cold neutron triple-axis spectrometers: TASP & RITA-II
- cold TOF: FOCUS   Backscattering: MARS

Enhanced ?

- At PSI we need larger energy range and intensity
  - ⇒ Thermal Neutrons Spectrometer
- Intensity / resolution

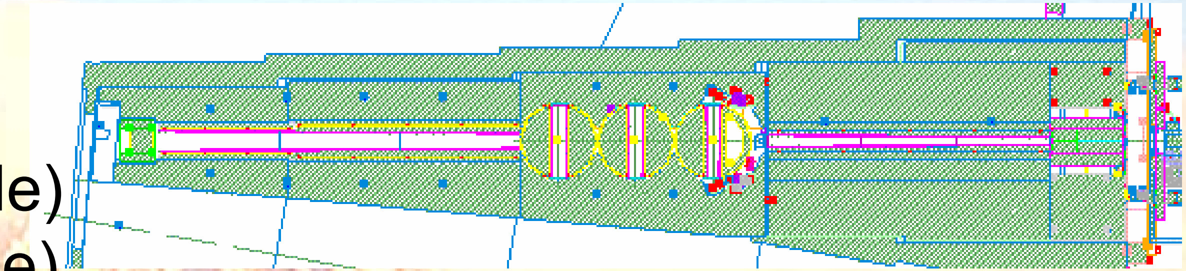




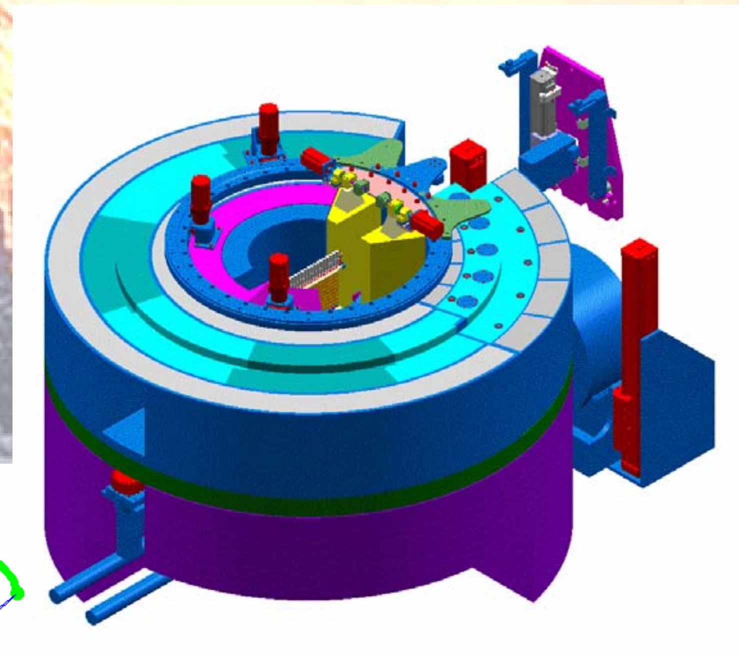


EIGER-CAMERA in three steps

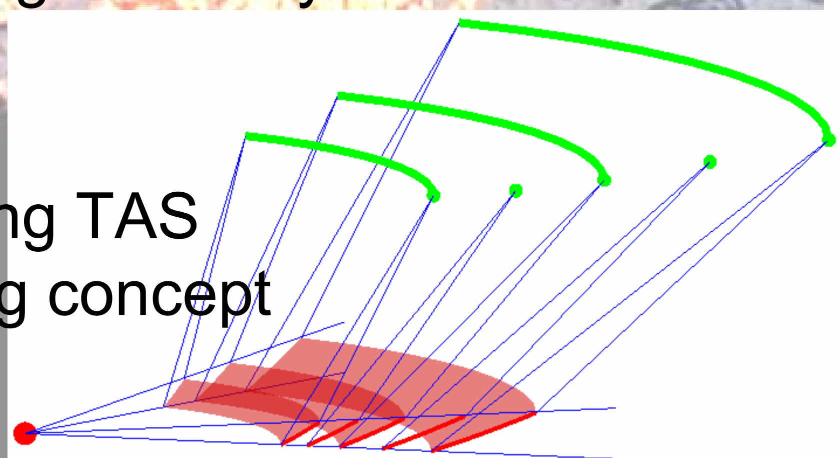
- In-pile
  - McStas choice:
  - Virtual source (3cm wide)
  - v.s. trumpet (12 cm wide)
    - 2x flux on sample
    - 4x bck and problem @ 2θ<20°



- Monochromator and shielding
  - Shielding optimised with MCNP (U. Filges)
  - Mono designed analytical

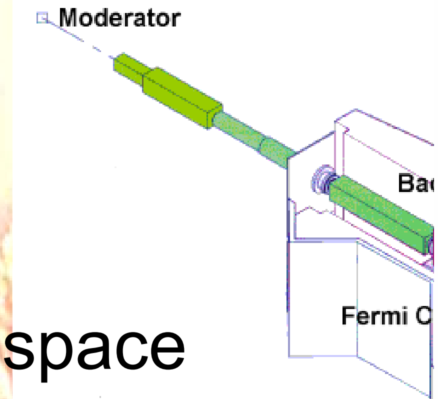


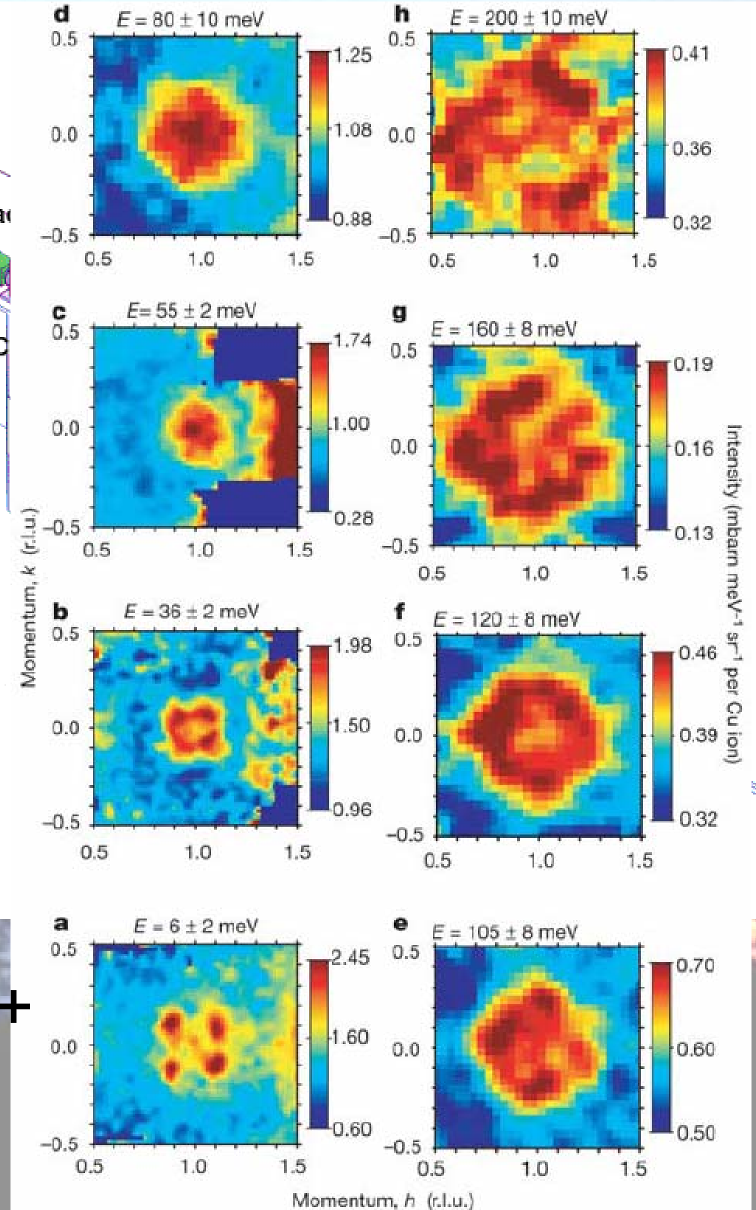
- CAMERA
  - multiplexing TAS
  - developing concept



'time-of-flight' (TOF)

- Direct geometry TOF
  - 2D or 3D-manifold in 4D momentum-energy space
- MAPS, ISIS, UK
  - $16 m^2$ detector $\Rightarrow$ $3x10^6$ Pixels
  - 10 crystals $\Rightarrow$ 50 g Sample
  - 7 Days $\Rightarrow$ 1 Data-set
  - 5 Years $\Rightarrow$ 4 PRL, 2 Nature +++

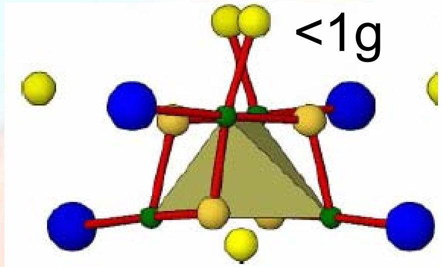


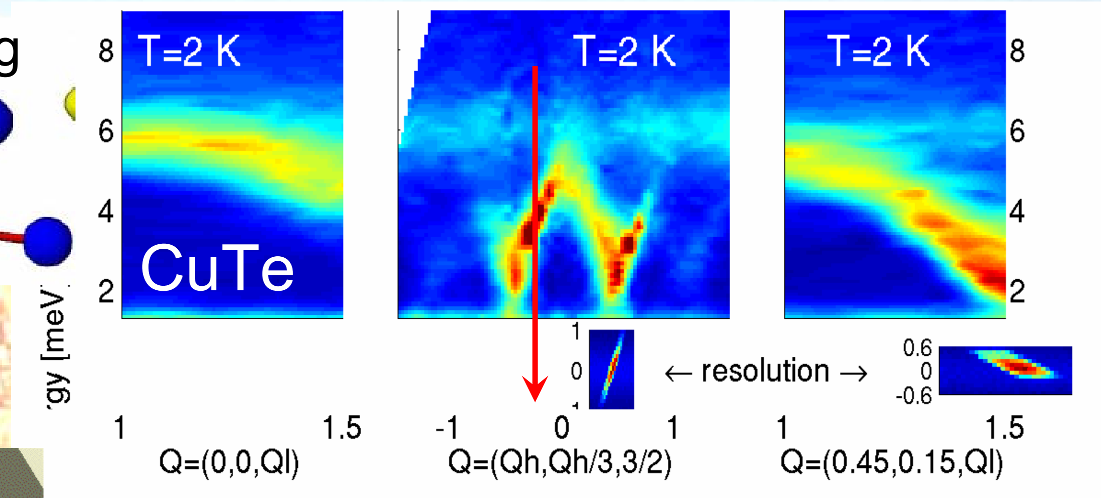


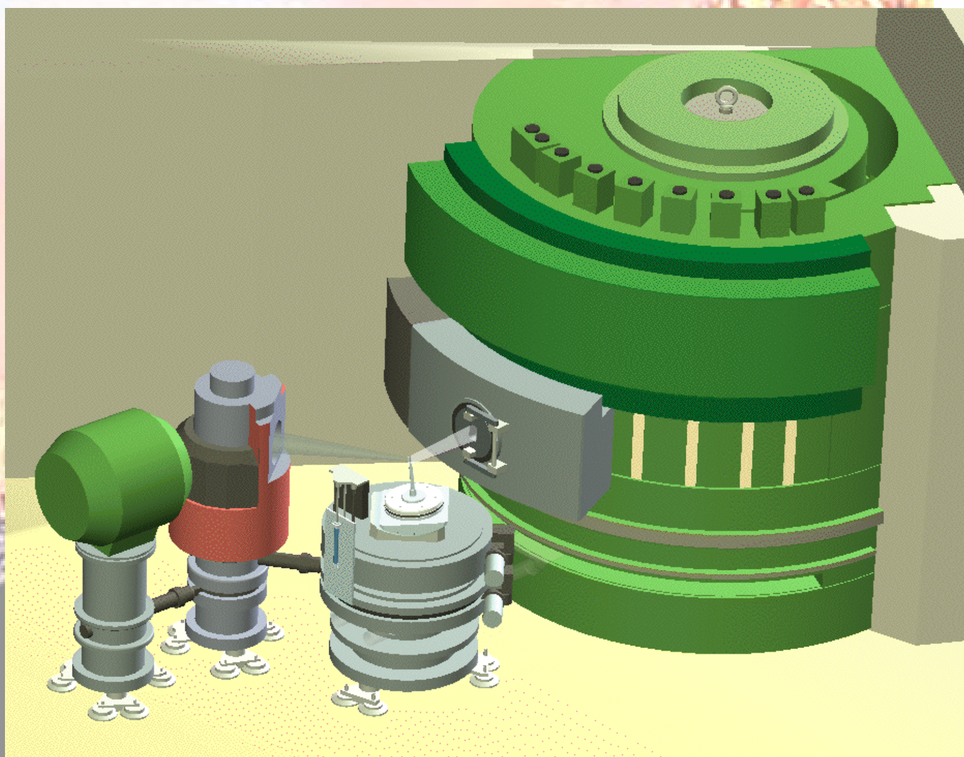
“State of the Art” TAS

IN8, TAS at ILL

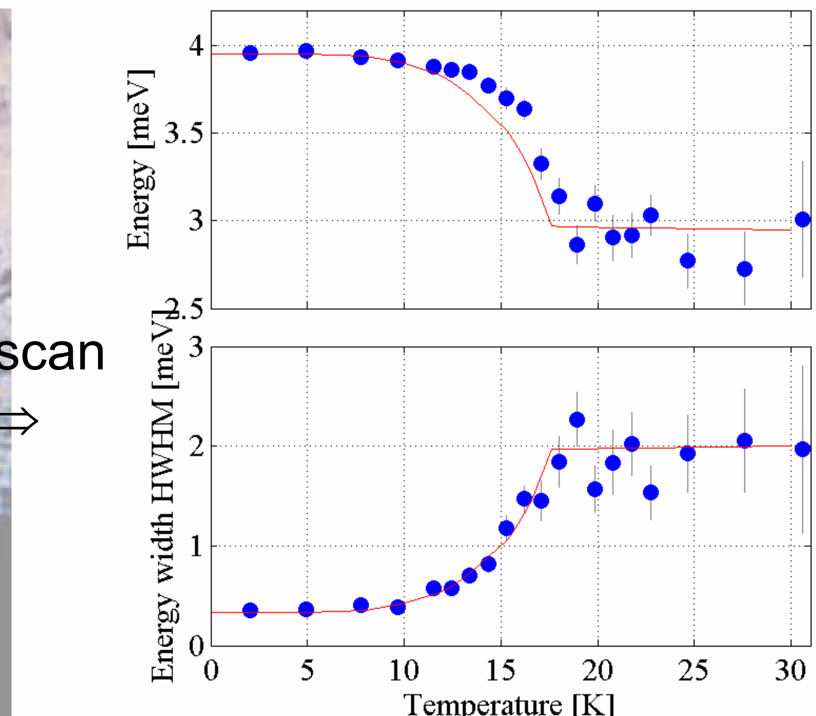
- 8x10^8 n/cm^{2}s
- Point-by-point
- 2D-Dataset in 6 h
- 21x41 pixel á 24 sec







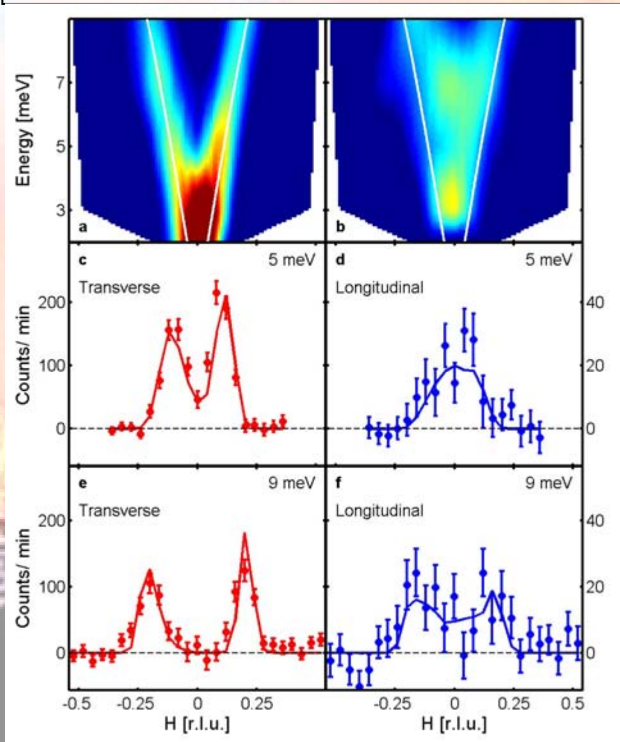
1 T-scan
5 h ⇒



TAS v.s. TOF ⇒ Multi-TAS

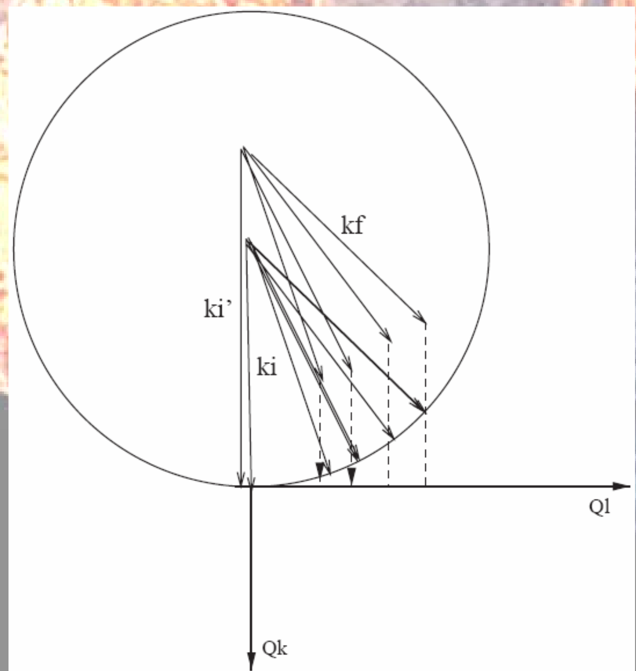
TAS

- Focus on <u>one</u> Point
- Flexible
- Already “optimal” (IN8, IN20..)



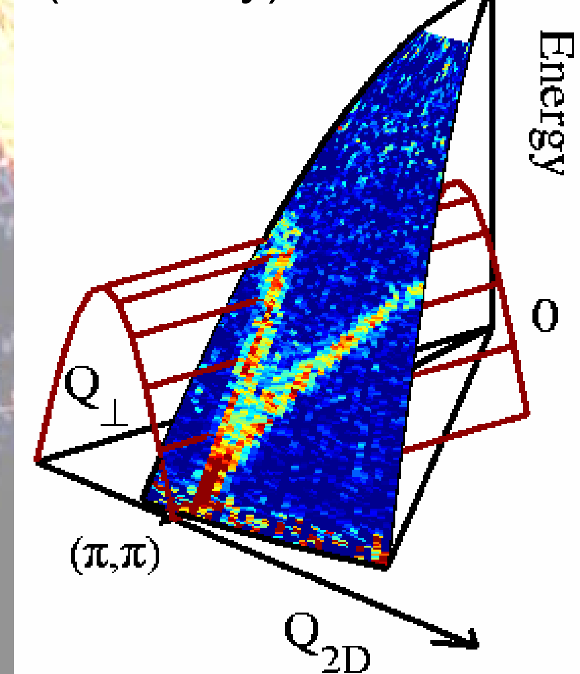
Multi-TAS

- a line in momentum-energy-space
- More Neutrons recorded than TAS
- More flexible than TOF



TOF

- 2-3D manifold
- Overwiew – sees “everything”
- Less flexible
- Still improving (6+ today)



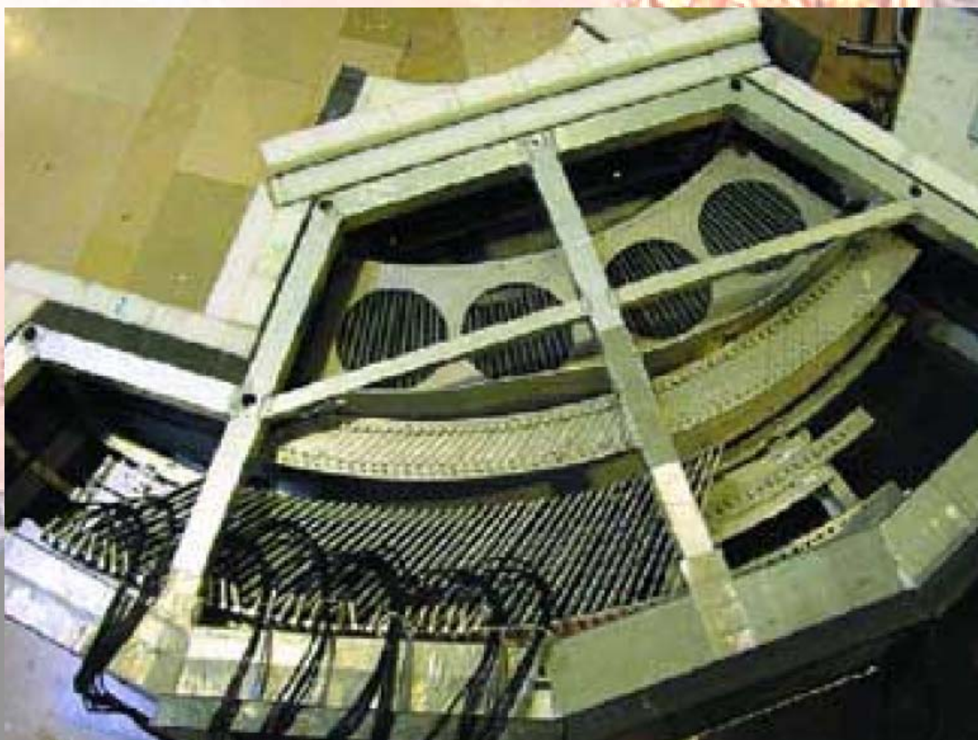
EIGER

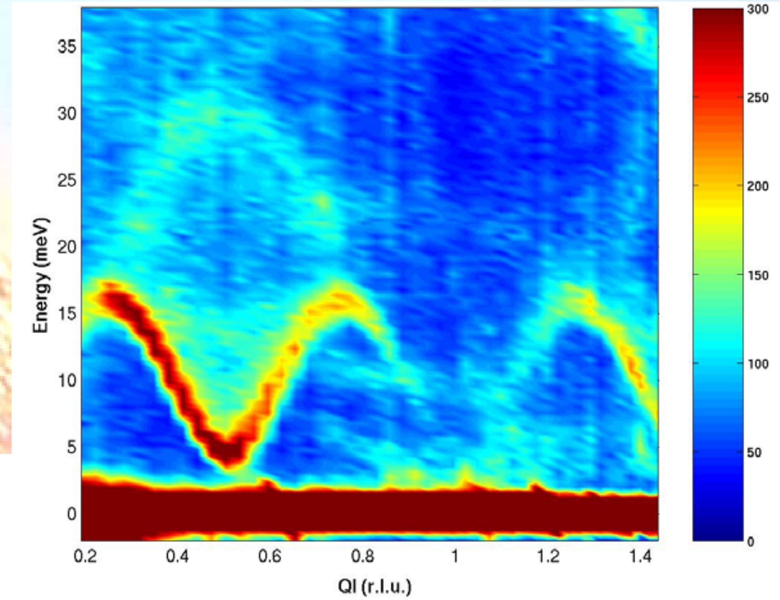
MAD – Multi-Analyser-Detector

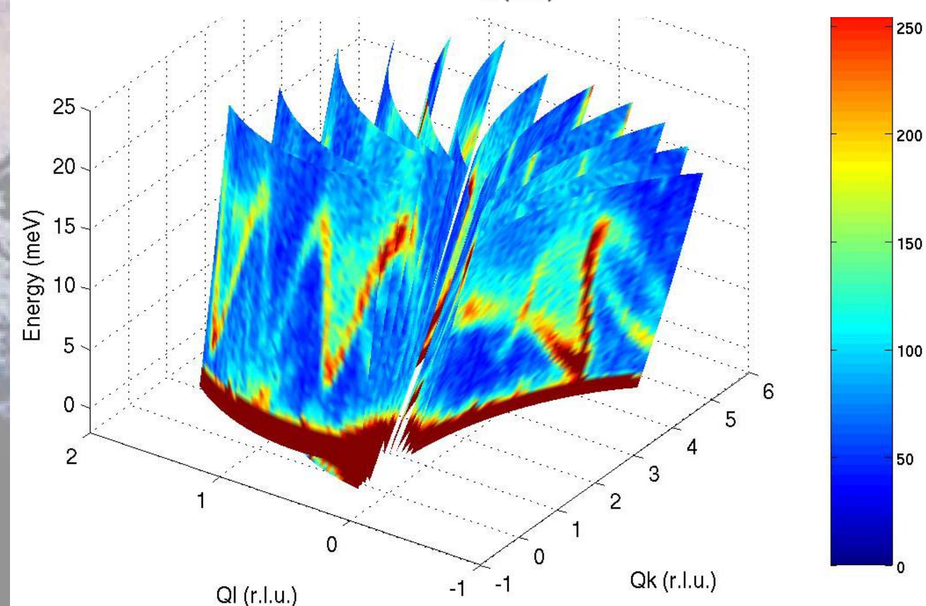
- ILL, IN3 ⇒ IN8 !
- 47 x 0.33º Detectors
- constant E_f=30 meV
- PSI crew, F. Demmel, M. Jimenez-Ruiz et al.

$CuGeO_3$

0.7 cm^3





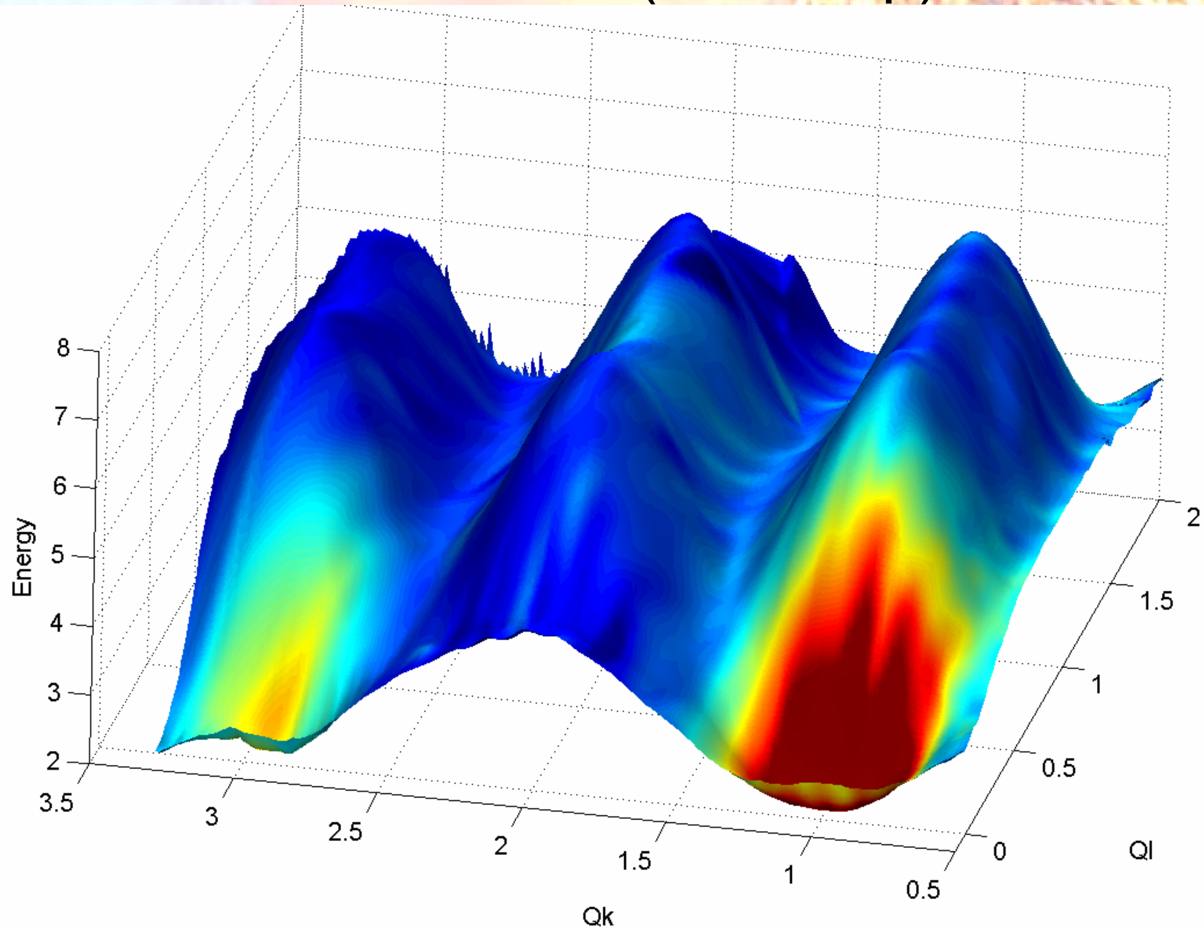


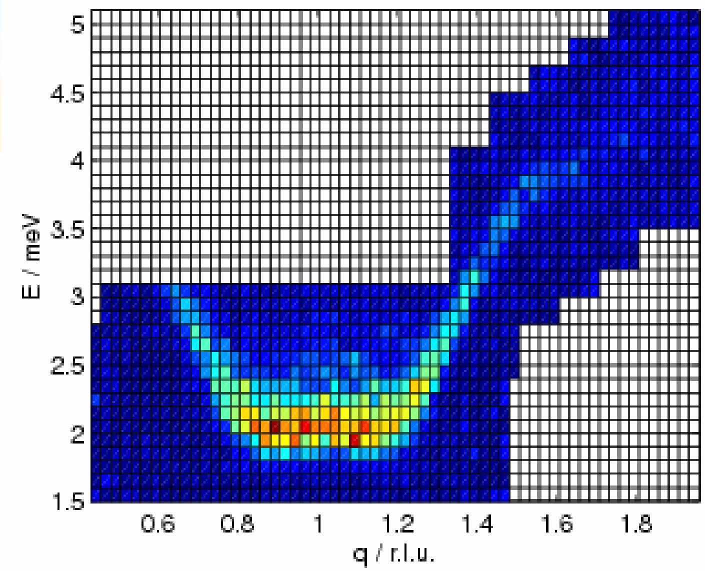
Beispiel: $LiNiPO_4$

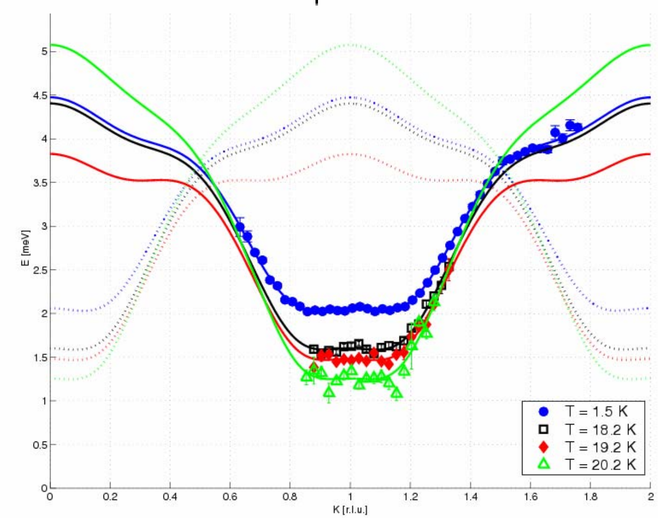
– High resolution around gap RITA-II

– Entire dispersion in 4h @ IN8+MAD
20 scans ⇒ ~1000 (Q,E,Amp) Points

T Jensen (Riso), HMR & M Kenzelmann (PSI), D Vaknin (Ames Lab)



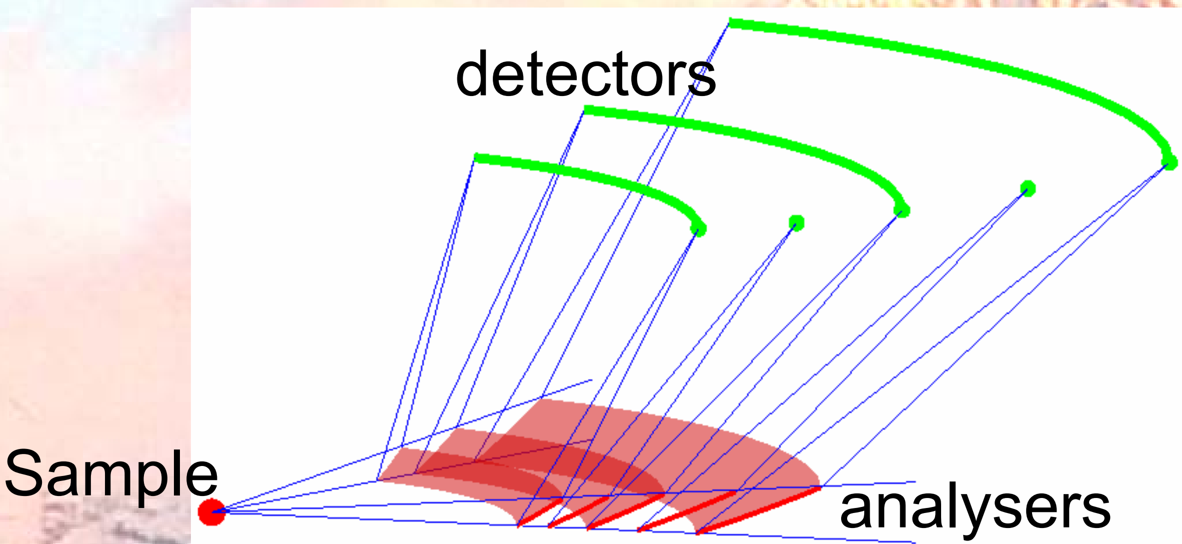


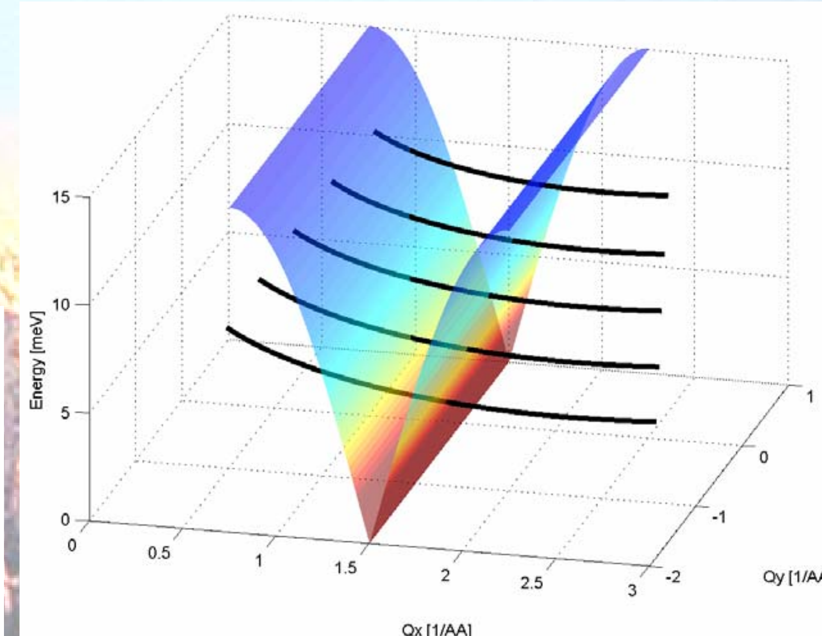


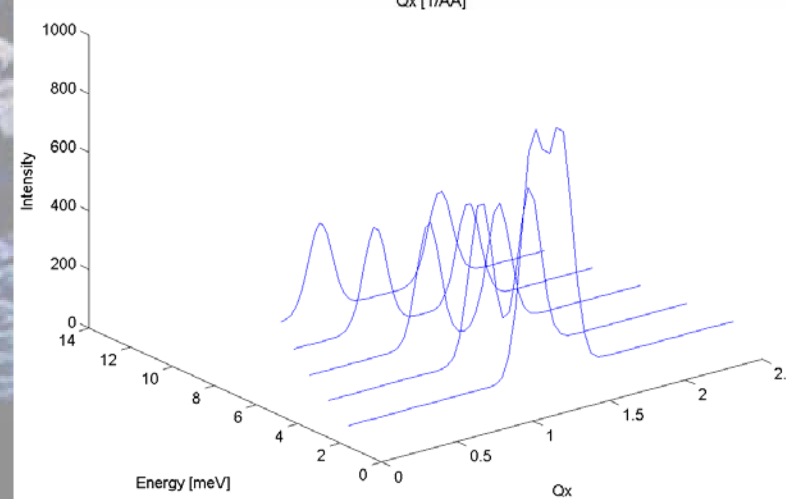
EIGER

CAMEA

- Multi-Analyser-Detector-System: Hybrid between point-to-point triple axis (TAS) and time-of-flight (TOF) mapping



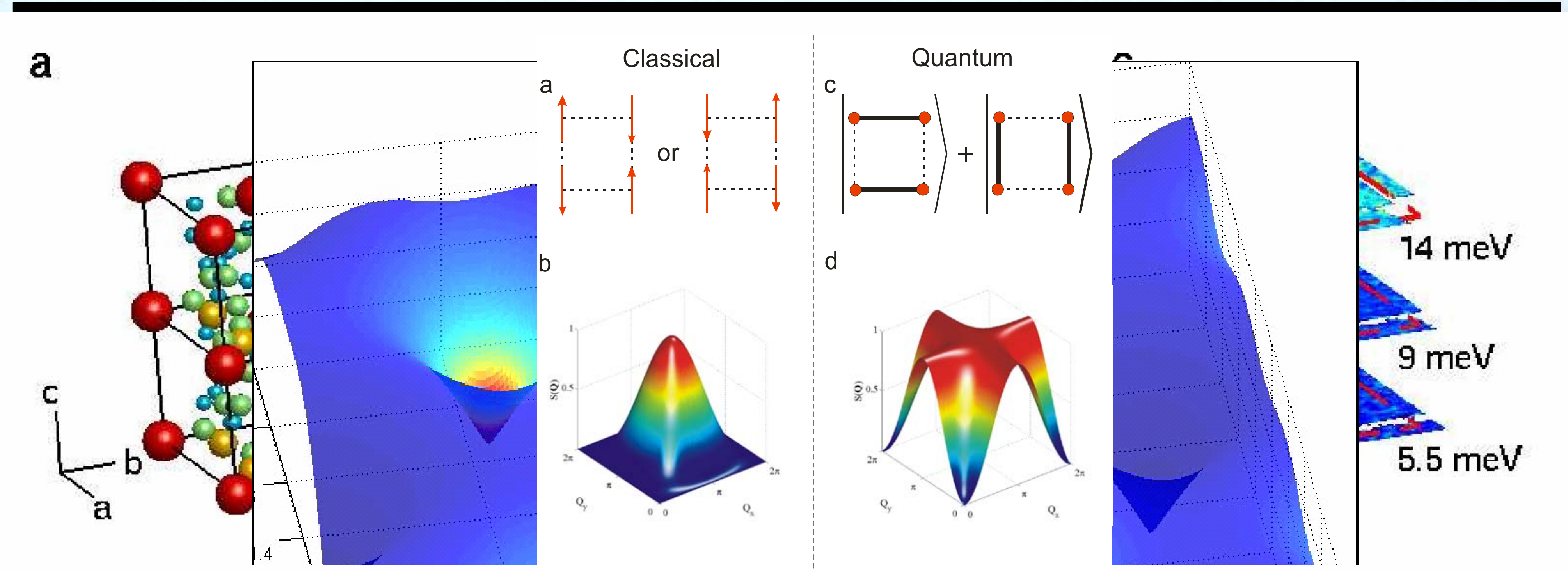


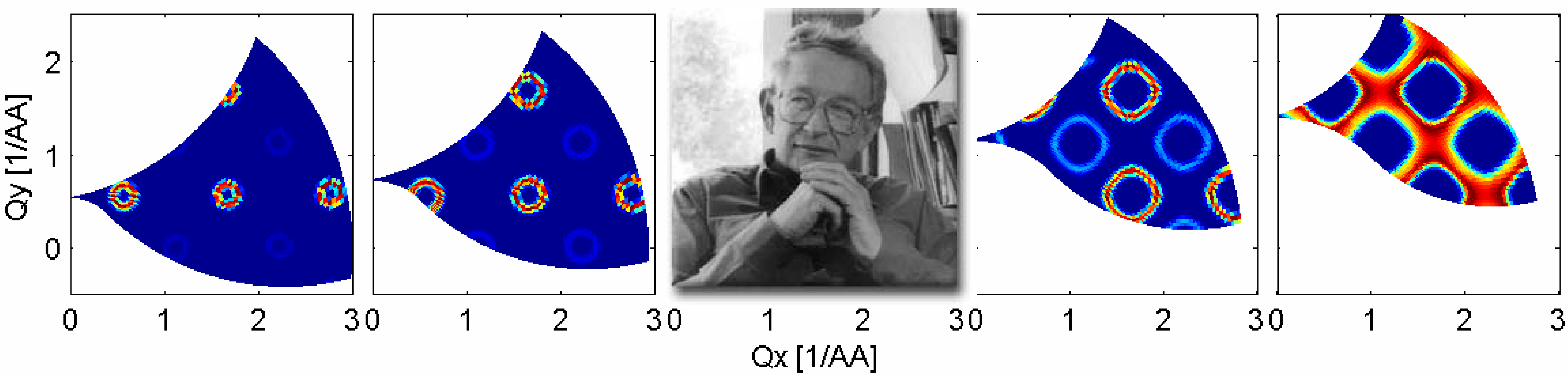


- 60º continuous angle coverage
  $\Rightarrow$ x12-20 over conventional TAS
- 5 successive analysers $\Rightarrow$ x 4.5

EIGER

Simulation $Cu(DCOO)_2 . 4D_2O$





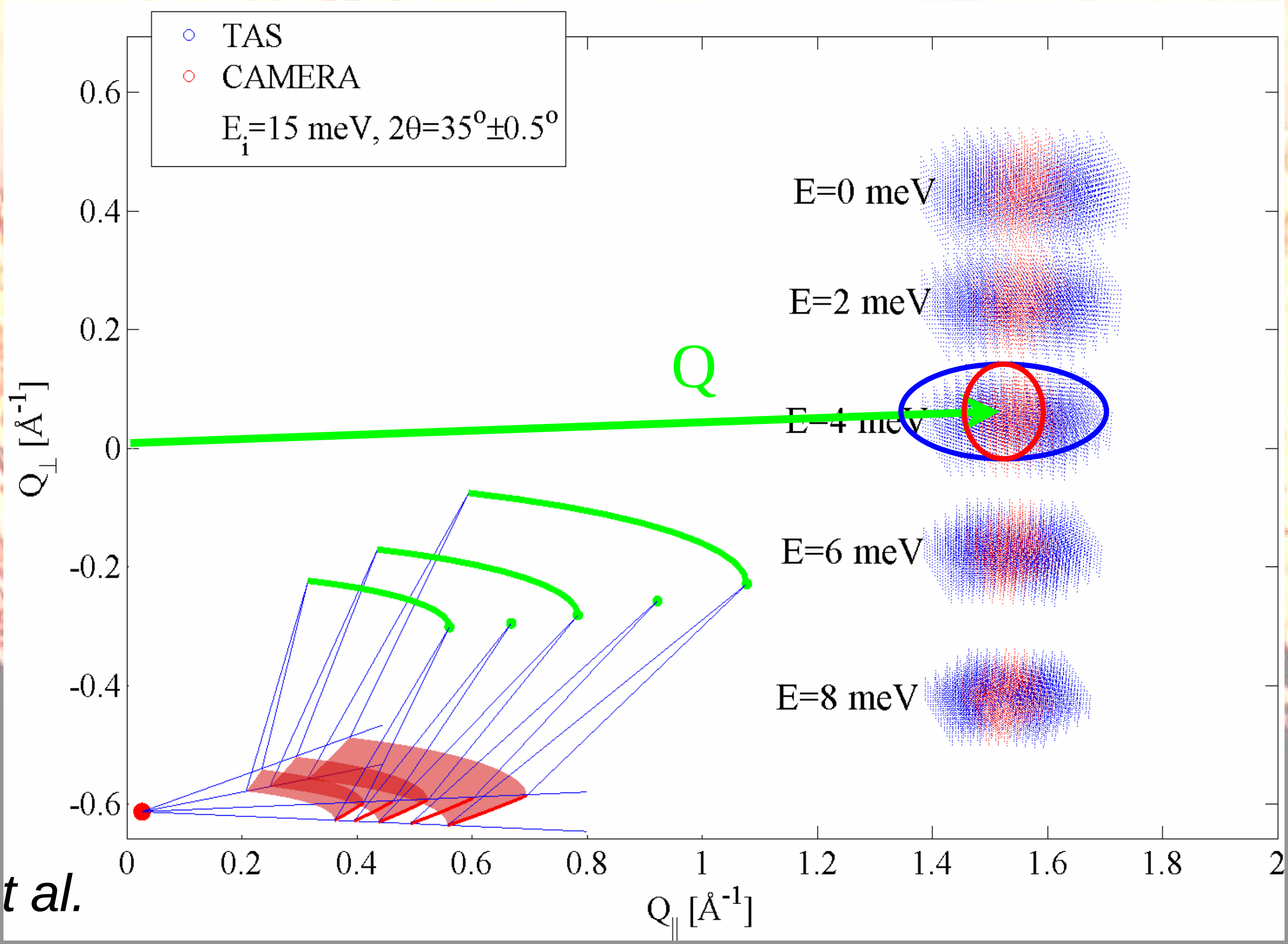
CAMERA Resolution

Horizontal scattering dogma invalid for focusing !

Vertical resolution already bad
  – we focus again
    in this direction
  ⇒ optimal energy-resolution

In-plane resolution
  normally dominated by
  focusing analyser

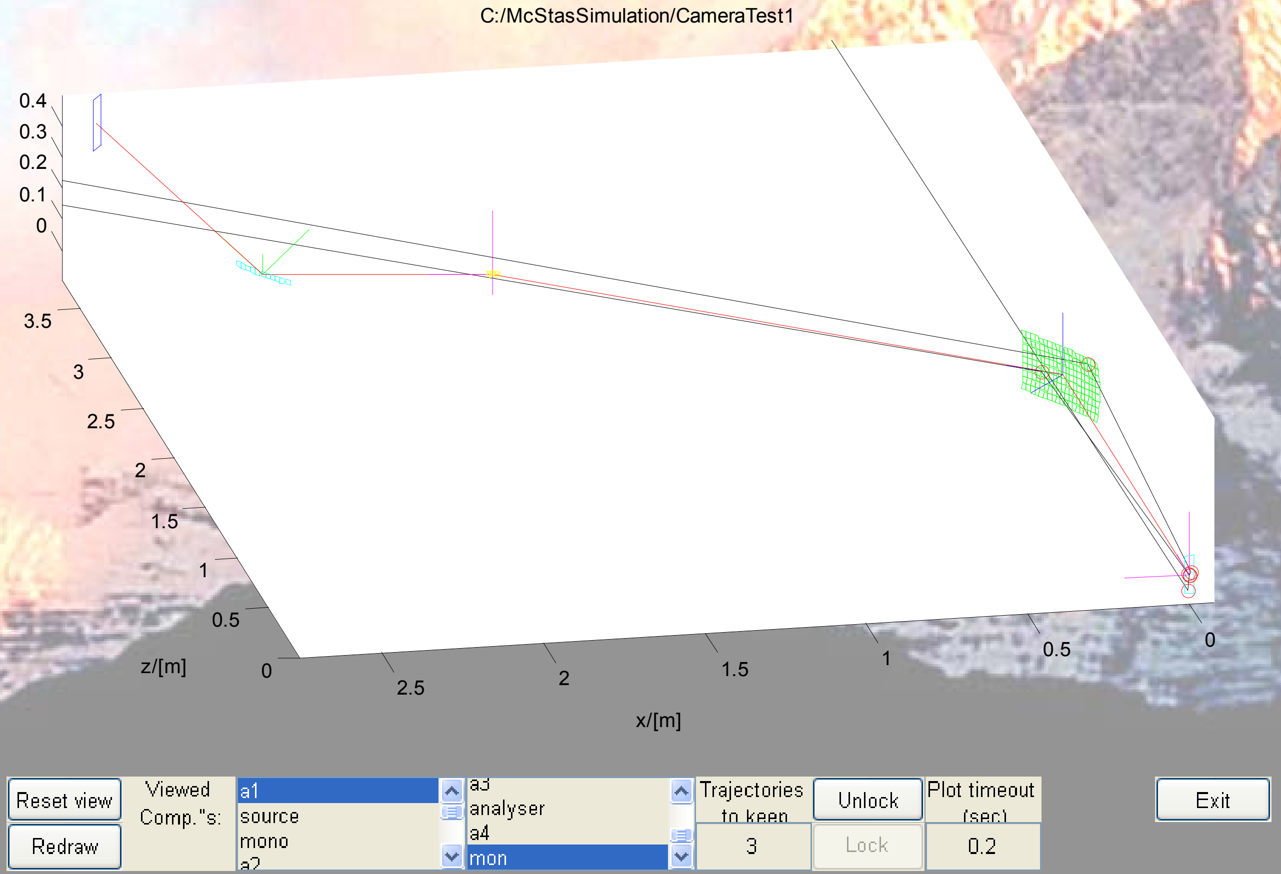
CAMERA makes it round
  instead of elliptic
  ⇒ ×3 in resolution

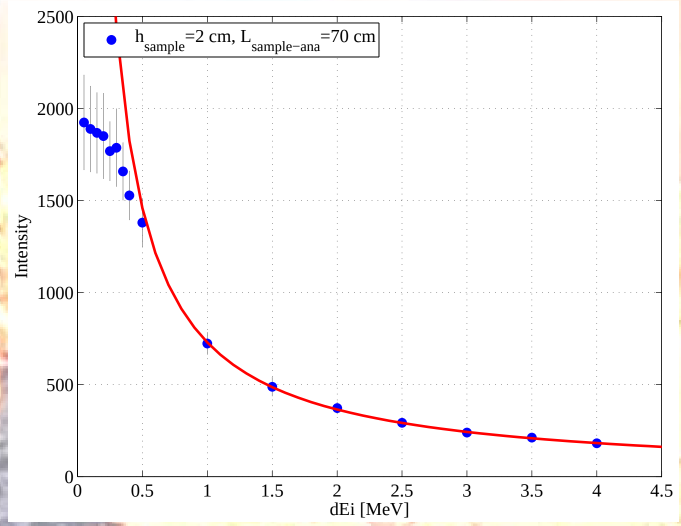


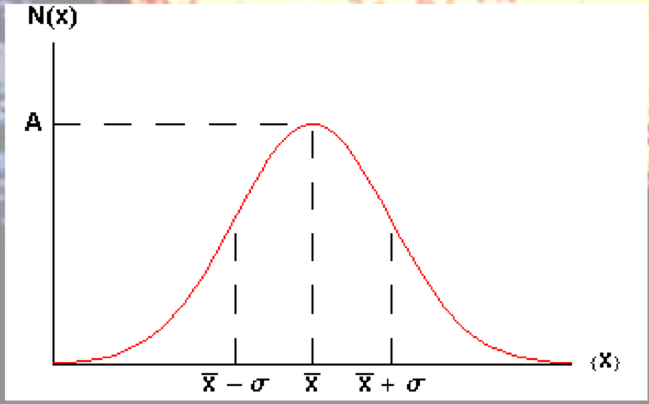
Con:
  sample height < 2cm
  more than $(2\text{cm})^3$ ⇒ MAPS *et al.*

McStas of CAMEA setup (R. Haque)

- Setup: Source⇒sample sampling dEi :

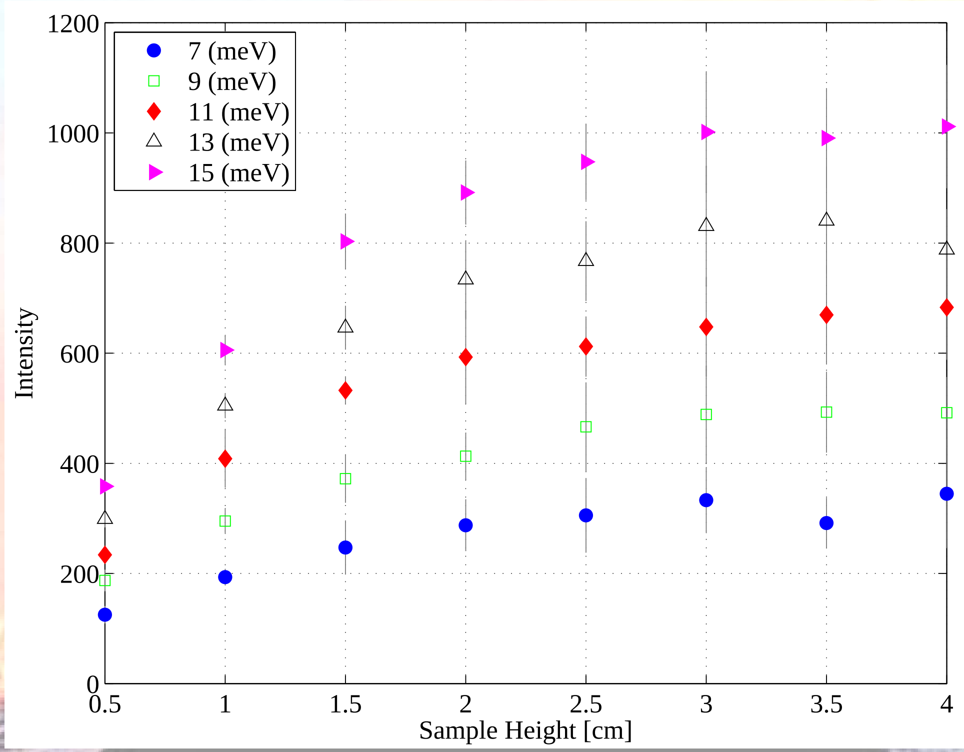


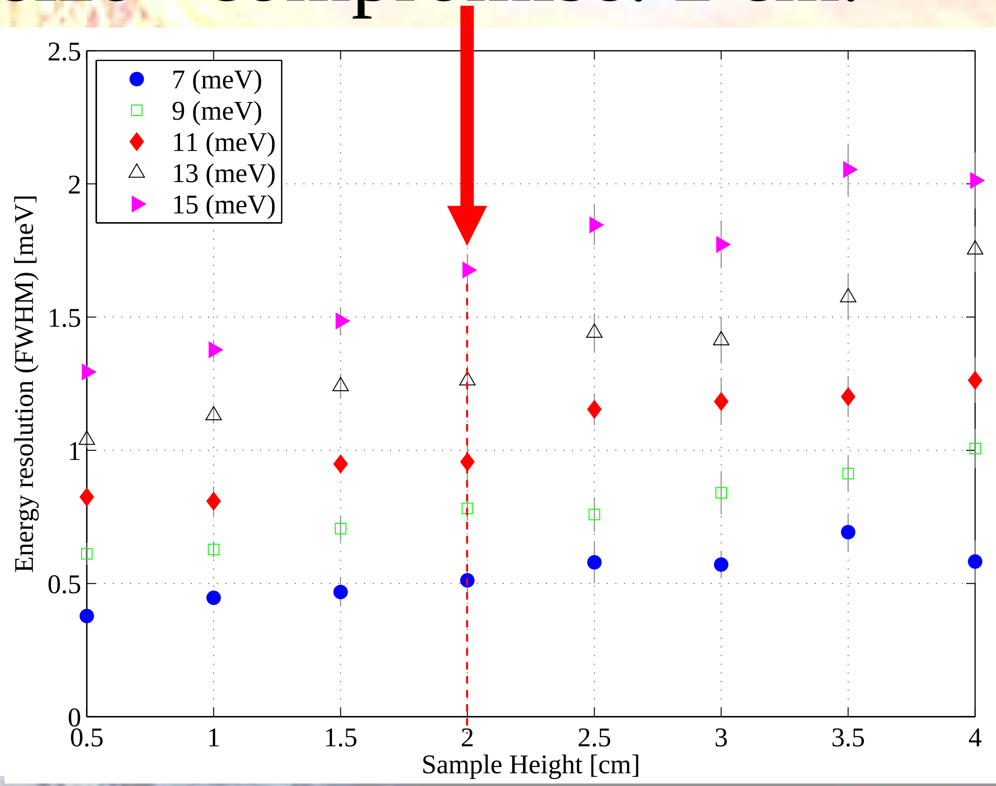




Sample height:

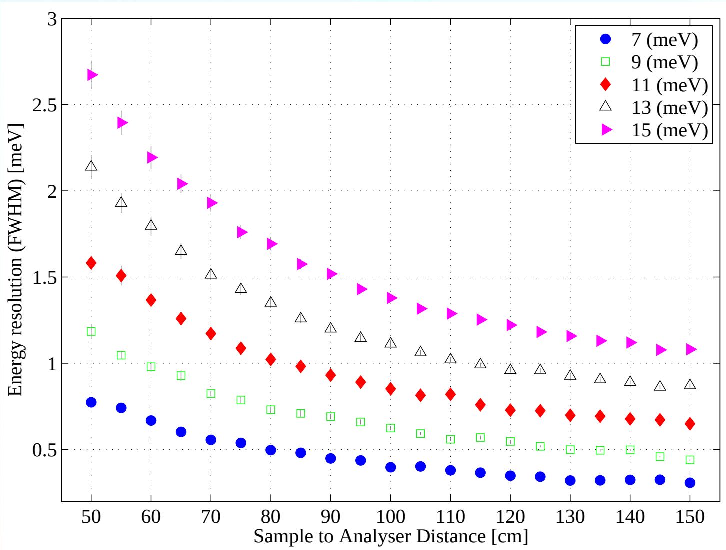
- Intensity plateau at 3 meV – hot-spot from mono
- Resolution increase with size - compromise: 2 cm.

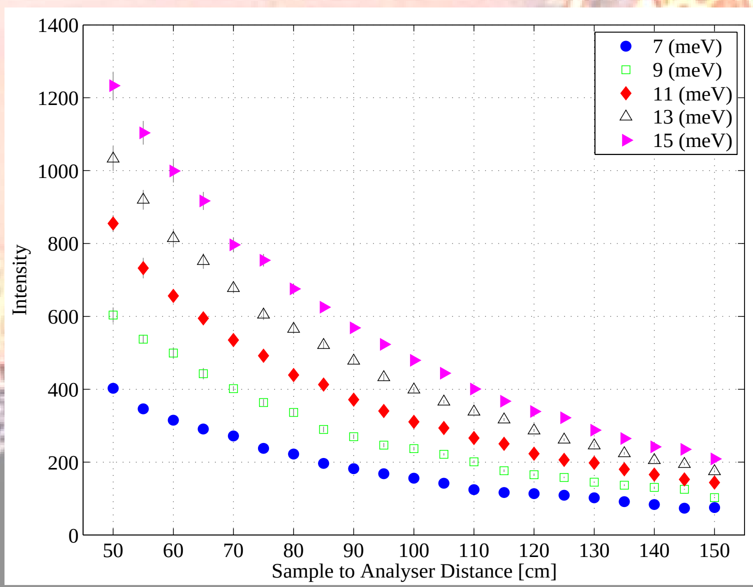




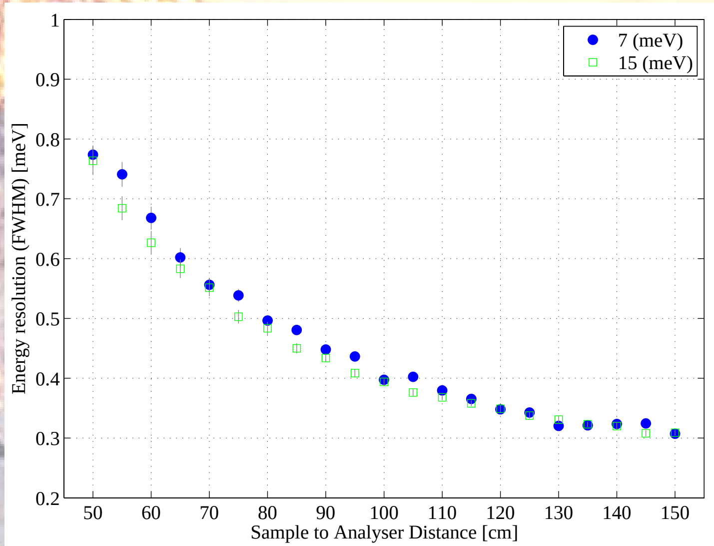
- Remaining simulations optimised for 2 cm choice.

Sample to analyser distance?





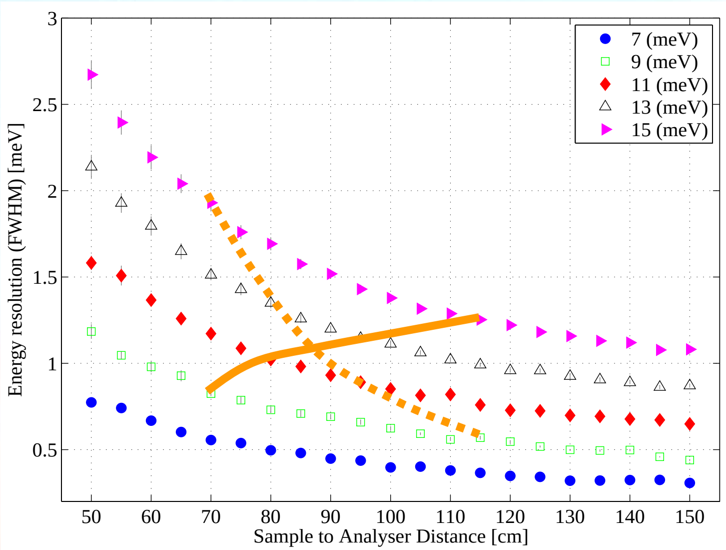
- Is there an optimal distance? *e.g.* a plateau in resolution(L)

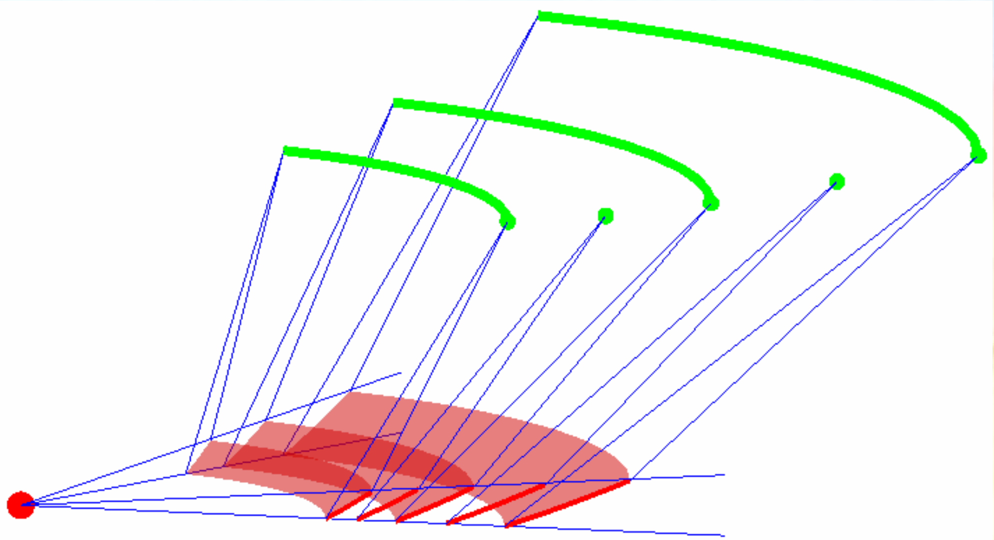


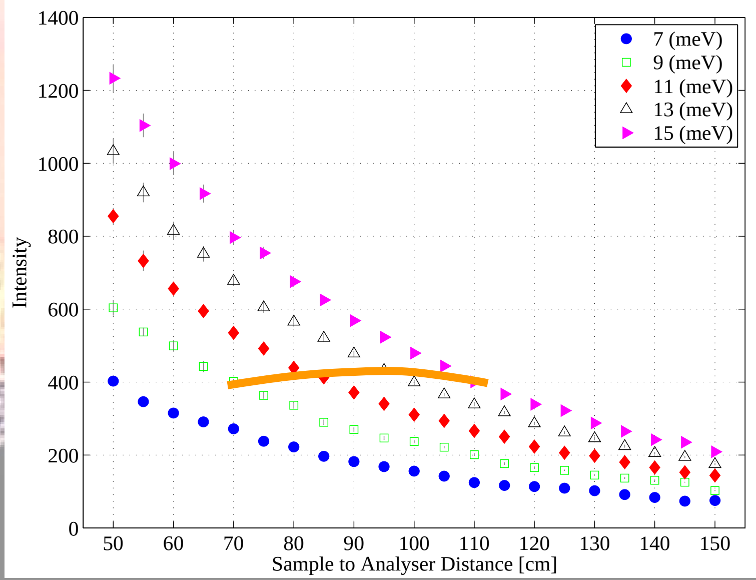
- No plateau – just compromise intensity/resolution/price

EIGER

Order of blades



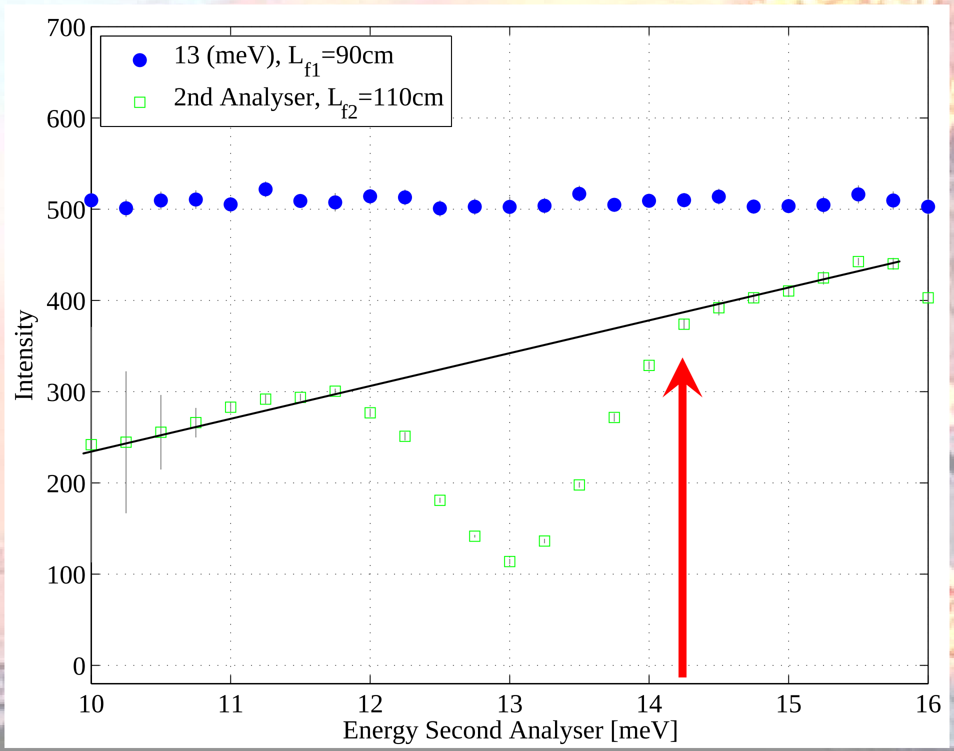




- Having lowest energies first, reduce difference in intensity and resolution.
- (but is more expensive)

Cross-talk?

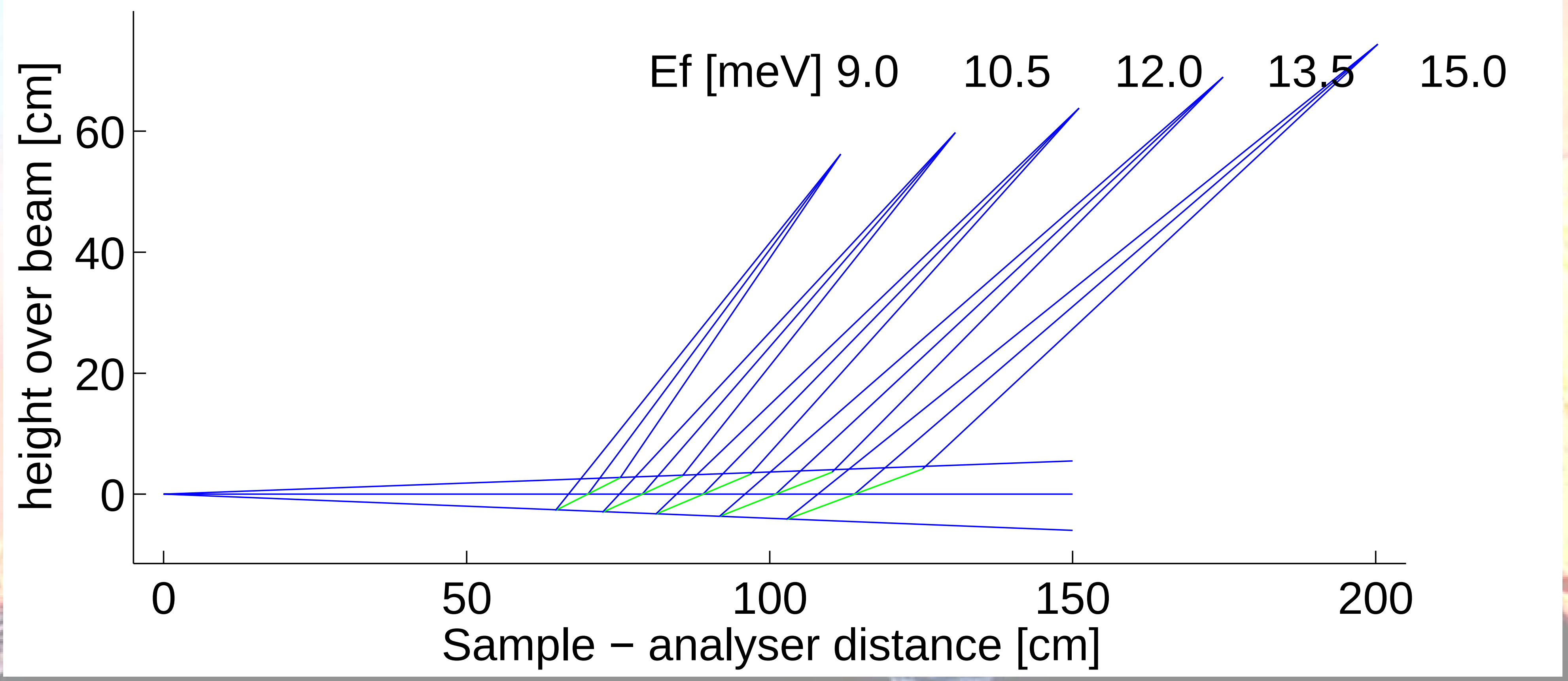
- Fix one blade, scan energy of next blade
- Find minimum distance (in energy) between blades (1.5 meV in this case)



Analyser Energy (meV)	Minimum Energy Separation between Successive Blades(meV)
5	± 0.25
7	± 0.50
9	± 0.75
11	± 1.00
13	± 1.25
15	± 1.50

‘Final’ choice of energies

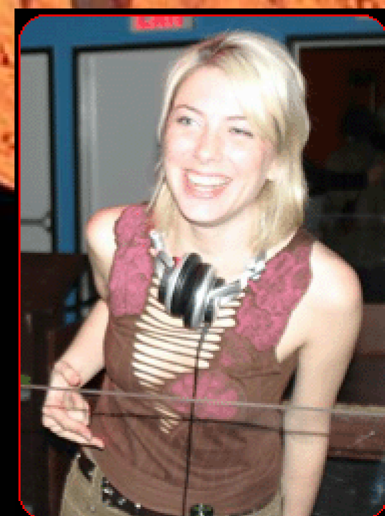
- Equidistant blades ⇒ easier data-analysis.



EIGER crew !

- Dieter Graf
- Uwe Filges
- Rahel Haque
- Joel Mesot, Bertrand Roessli, Christof Niedermayer
- Ch. Kaegi, T. Muehlebach, M. Horisberger, M. Schild, P. Keller, G. Theidel, P. Allenspach
- O. Morath

EIGER ⇑ CAMEA ⇒



(no myth – a Seattle DJ)